HOME MIXING OF FERTILIZERS

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What Are Commercial Fertilizers?

Commercial fertilizers may be individual fertilizer materials, which usually contain only one, but sometimes contain two or all three, of the plant-food constituents, nitrogen, phosphoric acid, and potash. Most frequently, however, they are mixtures of such materials, the relative quantities of which have been chosen so as to give a product that contains the three plant-food constituents in desired proportions. Such mixtures are known as complete mixed fertilizers, or simply as complete mixtures. Occasionally mixtures containing only two of the three constituents are sold. In practically every State, the farmers' interests are protected by laws that compel guarantees of the minimum contents of the plant-food constituents in mixed fertilizers and fertilizer materials.

Benefits Possible From Home Mixing

Some fertilizer materials can be bought and mixed on the farm. Home mixing may be more economical than the purchase of factory-made mixtures. It has an educational value, since it serves as an incentive toward acquiring a knowledge of different fertilizer materials and their agricultural values. It encourages experimentation to ascertain what mixtures are best adapted to particular soils and crops. It insures precise knowledge of the ingredients of the mixtures and the ability to duplicate any mixtures that may prove particularly desirable. In some localities, the farmer has a chance to buy so-called open-formula[1] mixed fertilizers, the manufacturer stating plainly the ingredients used in making the fertilizer and the pounds of each ingredient in a ton of the product. In such cases the last-mentioned reason for home mixing is removed.

Where only small quantities of fertilizers are to be used, it is usually more convenient to buy commercial mixtures. Such mixtures may also be best suited to the needs of the farmer who does not have time or the facilities for home mixing or is not in a position to study the subject.

Purchasing Fertilizer Materials

Although scores of fertilizer materials are used in the manufacture of factory-mixed fertilizers, it is advisable for the farmer, whose facilities for mixing are necessarily limited, to restrict himself to the purchase and use of a few materials, preferably those listed in table 1.

[1] The formula of a fertilizer mixture is a statement of the quantities and grades of the materials used in making the mixture.

TABLE 1.—*Composition of the principal fertilizer materials available for home mixing*

Material	Nitrogen	Phosphoric acid	Potash
Supplying nitrogen:	*Percent*	*Percent*	*Percent*
Nitrate of soda (sodium nitrate)	15.0–16.2		
Sulphate of ammonia (ammonium sulphate)	19.5–21.2		
Dried blood (blood meal)	9.0–14.0	0.5– 5.0	
Tankage (animal tankage)	5.0–10.0	3.7–13.8	
Dried fish scrap	6.5–10.0	5.0– 8.0	
Cottonseed meal	5.5– 7.5	1.5– 3.0	1.5– 2.0
Castor pomace	4.0– 7.0	1.0– 1.5	1.0– 1.5
Calcium cyanamide (Cyanamid)	21.0–23.7		
Urea (Uramon)	42.0–46.2		
Supplying phosphoric acid:			
Superphosphate		16.0–22.0	
Double (treble, triple) superphosphate		40.0–50.0	
Ammophos A	10.4–11.7	47.0–52.6	
Ammophos B	15.8–16.8	20.0–22.8	
Bonemeal	1.5– 4.0	20.0–30.0	
Supplying potash:			
Muriate of potash (potassium chloride)			47.0–61.5
Sulphate of potash (potassium sulphate)			47.0–52.0
Manure salts			25.0–32.0
Kainit			20.0–22.0
Sulphate of potash-magnesia			26.0–29.0
Tobacco stems	1.3– 1.6		4.4– 5.4
Hardwood ashes		1.0– 2.0	1.5– 8.0

In the purchase of fertilizer materials good business judgment should be used. Wide competition should be sought and prices procured not only from local merchants but from large fertilizer firms in the home State and adjoining States. Lists of firms may be obtained from the State agricultural experiment stations and the United States Department of Agriculture. Advice should be sought from the county agent. Best prices can be obtained for cash. Materials should be bought well in advance, as this not only insures a better price but allows the use of farm labor in the winter, when it is often not occupied profitably. Home mixing may be done in the barn when the weather is too inclement for outside work.

Mixing Commercial Fertilizers

The mixing of the materials is comparatively simple. Any tight floor or a wagon box may be used, and the tools at hand may be employed (fig. 1). The materials are spread in layers, usually the most bulky first, and are thoroughly shoveled together. The mixture is passed through a screen, and any lumps present are broken up with a tamper or the back of a shovel. The senior author has found a very large long-handled mortar hoe a convenient tool for mixing, but its purchase especially for this purpose is not necessary. Where large quantities are to be mixed, it would probably pay to buy a rotary mixer such as is sold for concrete mixing on the farm. The stirring should be continued until the materials are uniformly mixed and show no streaks of color, after which the product may be bagged and stored in a dry place until applied.

To avoid dampness, caking, and losses of plant-food constituents, certain materials should be used only sparingly or not at all with other materials. Thus neither wood ashes nor calcium cyanamide (Cyanamid) should be mixed with sulphate of ammonia, Ammophos,

or other ammonium salts. Not more than about 150 pounds of Cyanamid should be used per ton of superphosphate in mixtures. Neither quicklime nor slaked lime should be used in making fertilizer mixtures.

When making mixtures from high-analysis materials it is well to include at least 100 to 200 pounds per ton of the mixture of some organic material, such as fish scrap, animal tankage, or cottonseed meal as a conditioner. This holds good especially when the mixture is to be stored.

One of the easiest ways to start home mixing is to duplicate a formula already in use. A beginner should select a mixture which has been successfully used on similar soil on the crop he intends to

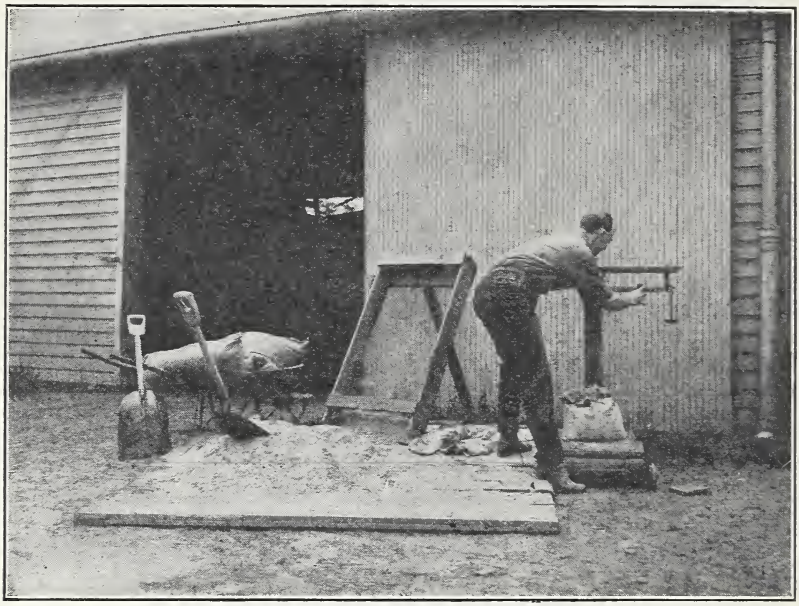

FIGURE 1.—Implements used in home mixing.

raise, get a price on the mixed goods, and then find out what a home mixture of similar analysis will cost.

In making up fertilizer formulas it is well first to decide what percentages are required and then what materials shall be used. Start with the phosphoric acid (P_2O_5). Superphosphate is almost universally used as a source of the phosphoric acid in ordinary-strength fertilizers. With 16-percent goods, if 8 percent of phosphoric acid is desired in the mixture, the procedure would be as follows: If the whole mixture were superphosphate, it would contain 16 percent of phosphoric acid; as 8 percent is desired, make eight-sixteenths (one-half), or 1,000 pounds, of the mixture superphosphate; if 6 percent is wanted, six-sixteenths, or 750 pounds, to a ton would consist of this material. Similarly with nitrogen, if nitrate of soda contains 16 percent of nitrogen and 2 percent of nitrogen is desired, two-sixteenths, or one-eighth, of the mixture, or 250 pounds in a ton, will be needed. Similarly with potash, if potassium chloride containing 50 percent of

potash is used and 5 percent of potash is desired, five-fiftieths, or one-tenth, of a ton of potassium chloride (200 pounds) is needed.

Quantities of any other material may be determined in a similar manner. It is not necessary for the farmer to be exact down to the fraction of 1 percent, as fertilizer application is not an exact science and a slight variation in the calculation will not alter materially the agricultural value of the mixture.

Fertilizer materials are often used to advantage without being mixed. Examples are superphosphate, basic slag, nitrate of soda, and sulphate of ammonia.

Table 2 will be of help in calculating home mixtures. In making ton lots, to get 1 percent, use the quantities shown in the first column; to get 2 percent, use those in the second column; and so on.

TABLE 2.—*Quantities of fertilizer ingredients to be used to give definite percentages in a ton of mixture* [1]

Ingredient	1 per-cent	2 per-cent	3 per-cent	4 per-cent	5 per-cent	6 per-cent	7 per-cent	8 per-cent	9 per-cent	10 per-cent
Carriers of nitrogen (N):	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Nitrate of soda (15 percent N)	133	266	400	532	666	800	933	1,066	1,200	1,333
Nitrate of soda (16 percent N)	125	250	375	500	625	750	875	1,000	1,125	1,250
Sulphate of ammonia (20 percent N)	100	200	300	400	500	600	700	800	900	1,000
Cottonseed meal (7 percent N)	285	571	856	1,142	1,428	1,714	2,000	------	------	------
Dried blood (10 percent N)	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
Fish scrap (8 percent N)	250	500	750	1,000	1,250	1,500	1,750	2,000	------	------
Urea (42 percent N)	48	96	143	191	238	286	334	381	429	477
Carriers of phosphoric acid (P_2O_5):										
Superphosphate (16 percent P_2O_5)	125	250	375	500	625	750	875	1,000	1,125	1,250
Superphosphate (20 percent P_2O_5)	100	200	300	400	500	600	700	800	900	1,000
Double superphosphate (40 percent P_2O_5)	50	100	150	200	250	300	350	400	450	500
Ground bone [2] (23 percent P_2O_5)	87	174	261	348	435	522	609	696	783	869
Carriers of potash (K_2O):										
Potassium sulphate (50 percent K_2O)	40	80	120	160	200	240	280	320	360	400
Potassium chloride (50 percent K_2O)	40	80	120	160	200	240	280	320	360	400
Kainit (20 percent K_2O)	100	200	300	400	500	600	700	800	900	1,000
Manure salts (30 percent K_2O)	67	134	200	267	334	400	467	533	600	667

[1] Where the combined materials do not total 2,000 pounds a filler may be used to bring up the mixture to that weight, if desired.

[2] Ground bone also carries nitrogen.

Examples

To make up a ton of a 4–8–4 mixture in which the nitrogen is one-third in the form of nitrate of soda, one-third in the form of sulphate of ammonia, and one-third in organic form from cottonseed meal, the phosphoric acid is from 20-percent superphosphate and the potash is from 50-percent potassium chloride, the following materials would be used:

	Pounds
Nitrate of soda (16 percent N)	168
Sulphate of ammonia	134
Cottonseed meal	380
Superphosphate	800
Potassium chloride	160
Filler	358
Total	2,000

Since the fertilizer materials add up to 1,642 pounds, 358 pounds of a filler would be added in commercial practice. This filler may be a

conditioner as well and often has some fertilizer value in itself. Dried peat, ground phosphate rock, ground limestone or dolomite, or even sand may be used. The home mixer, however, need not bother with a filler. When the total of the mixture is less than 2,000 pounds, a smaller quantity of fertilizer per acre may be used instead of diluting with a filler. Thus, instead of applying a ton of 4–8–4 mixture in which the sum of the materials used is 1,500 pounds without filler, by using three-fourths of the normal application, the filler can be omitted. If a mixture is to be stored for some time, the use of a filler as a conditioner may be desirable.

The mixture just given is a good general fertilizer. Its nitrogen is in different degrees of availability. The cottonseed meal in this mixture, besides having fertilizer value, is an excellent conditioner. A mixture such as this will drill well and, when properly stored, should remain several months in good drillable condition. It is possible to make other mixtures which would have the same ratio of nitrogen, phosphoric acid, and potash, such as 5–10–5, 8–16–8, 10–20–10, and even 15–30–15. As the number of units increases, however, the difficulty of keeping the mixture in condition and of distributing it evenly in the soil may increase.

A good cotton fertilizer is one containing 6 percent of nitrogen, 8 percent of phosphoric acid, and 4 percent of potash. A fertilizer of such a grade can be made from the cheaper nitrogen materials, ammonium sulphate and urea, with superphosphate and muriate of potash, provided limestone is included to neutralize the acid-forming qualities of these nitrogen sources. It is preferable to use dolomitic limestone or dolomite, for it not only neutralizes the acidity of the fertilizer but also supplies magnesium, which is needed on most cotton soils. This form of limestone produces no unfavorable chemical reaction in the fertilizer mixture and is a good conditioner. A fertilizer of this grade can be compounded by mixing the materials in the following proportions:

	Pounds
Superphosphate (18 percent P_2O_5)	890
Ammonium sulphate	300
Urea (42 percent N)	143
Potassium chloride (50 percent K_2O)	160
Dolomitic limestone	375
Filler	132
Total	2, 000

A 5–8–7 analysis might contain the following:

	Pounds
Nitrate of soda (16 percent N)	250
Ammonium sulphate	200
Animal tankage (8 percent N) or fish scrap	250
Treble superphosphate (40 percent P_2O_5)	200
Superphosphate (20 percent P_2O_5)	400
Potassium chloride	280
Filler or conditioner	420
Total	2, 000

This mixture contains 5 percent of nitrogen, 2 percent being supplied from nitrate of soda, 2 percent from sulphate of ammonia, and 1 percent from animal tankage (8 percent) or fish scrap; 8 percent of phosphoric acid, supplied partly from 20-percent superphosphate and partly from treble superphosphate (40 percent); and 7 percent of

potash from potassium chloride. Filler or conditioner may be dried peat, garbage tankage, or similar material. The example shows 4 percent of phosphoric acid from each source, but if it is desired to cut down the amount of filler this is readily done by putting in more 20-percent superphosphate and correspondingly reducing the amount of 40-percent goods. Potassium sulphate may be substituted for all or part of the potassium chloride used above, if desired.

This mixture is suitable for potatoes in a number of potato-growing sections, and also makes a good garden fertilizer, especially on sandy soils, which have a special need for potash.

A 10–16–14 mixture similar to the following has been used in New England for potatoes:

	Pounds
Ammophos 11–47	700
Nitrate of soda (16 percent N)	125
Ammonium sulphate (20 percent N)	100
Urea (46 percent N)	150
Fish scrap or tankage (8 percent N)	175
Potassium chloride (50 percent)	560
Sand or other filler	190
Total	2, 000

This is double a 5–8–7 mixture. A thousand pounds of this mixture contains as much nitrogen, phosphoric acid, and potash as 2,000 pounds of a 5–8–7 mixture. A carrier of soluble magnesium may be added to the above mixture if considered necessary. Other high-analysis mixtures are readily made up from materials now available on the market.

A 7–6–5 analysis may be made of the following materials:

	Pounds
Nitrate of soda	375
Ammonium sulphate	300
Cottonseed meal	285
Superphosphate (20 percent)	600
Potassium chloride	200
Filler and conditioner, dried peat, etc	240
Total	2, 000

This mixture is often used for early potatoes and truck crops on sandy soils in the eastern trucking regions. It is high in quickly available nitrogen.

An 0–20–20 analysis may be mixed as follows:

	Pounds
Potassium chloride (50 percent)	800
Treble superphosphate (40 percent)	1, 000
Dried muck or ground limestone	200
Total	2, 000

This is a fertilizer suitable for muck lands where it is felt nitrogen is not needed. Dried muck under these conditions is often available to the farmer as a conditioner.

A 2–12–6 analysis may be made as follows:

	Pounds
Ammonium sulphate	200
Superphosphate (20 percent)	1, 200
Kainit (20 percent)	600
Total	2, 000

This should be used as soon as mixed, as it may cake on standing. A 2–12–2 analysis may be made up by mixing the 4–8–4 mixture already given with an equal weight of 16-percent superphosphate. This will divide the percentage of nitrogen and potash in half and will build up the content of phosphoric acid to 12 percent. This example shows how the farmer may readily modify other fertilizer mixtures to suit his needs or wishes. Suppose he can purchase to advantage a concentrated fertilizer analyzing 15–30–15 but desires to use a fertilizer drill which he thinks more suited to a lower-grade mixture. He also prefers, because of local conditions, a greater proportion of phosphoric acid. He may combine 1 ton of 15–30–15 analysis commercial fertilizer, 1 ton of superphosphate (16 percent), and 1 ton of inert material, such as sand or sandy soil, and prepare 3 tons of approximately 5–15–5 goods. Other concentrated mixtures may be used in a similar manner.

Among simple mixtures which have given satisfaction for lawns are the following:

Ammonium sulphate	1 part.
Cottonseed meal	3 parts.

This is used as a top dressing for lawns where it is desired to make the soil more acid. It may be applied at the rate of 2 pounds per 100 square feet. It supplies nitrogen to stimulate leaf growth. Where it is desired to make the soil less acid, nitrate of soda may be substituted:

Nitrate of soda	1 part.
Cottonseed meal	3 parts.

A compromise mixture which should not change, to any great degree, the reaction of the soil is as follows:

Nitrate of soda	1 part.
Sulphate of ammonia	1 part.
Cottonseed meal	6 parts.

On many farms and gardens poultry manure is available. When this has been stored under cover it is a good material to use in home mixtures, if screened and pulverized. As it is relatively low in phosphoric acid the following mixture has been recommended:

Dried poultry manure	9 parts.
Superphosphate (16-percent)	1 part.

The superphosphate is a good preservative of the manure when mixed with it before or during storage.

Other dried animal manures are also satisfactory in fertilizer mixtures. A large amount of goat manure is brought to this country from South America for this purpose. Bat manure is available in certain sections.

Profits From Home Mixing of Fertilizers

Usually home mixing will show a profit, but the farmer will have to investigate and determine what materials and mixed goods cost in his community and then make his decision. The saving should decrease as higher-grade mixtures are made, as the fertilizer manufacturer is able to give the farmer better values in higher-analysis goods. The county agent is often in a position to help a farmer determine the relative advantages of commercial and home-mixed fertilizer.

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